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$$\therefore \frac{1+at+bu}{\sqrt{[1+a^2+b^2]}} = \frac{1+ct+du}{\sqrt{[1+c^2+d^2]}} = \frac{1+ft+gu}{\sqrt{[1+f^2+g^2]}} \text{ determines } t \text{ and } u.$$

$$e^2 = \tan^2 \theta = \frac{(t-a)^2 + (u-b)^2 + (au-bt)^2}{(1+at+bu)^2}, \quad e_1^2 = \frac{(t-a)^2 + (u+b)^2 + (au+bt)^2}{(1+at-bu)^2},$$

$$e_2^2 = \frac{(t+a)^2 + (u-b)^2 + (au+bt)^2}{(1-at+bu)^2}, \quad e_3^2 = \frac{(t+a)^2 + (u+b)^2 + (au-bt)^2}{(1-at-bu)^2}.$$

145. Proposed by FRANK GIFFIN, Graduate Student, State University, Boulder, Col.

If A and B be the points of contact, upon two circles X and Y , of tangents drawn from any point of their circle of similitude, then the tangent from A to Y is equal to the tangent from B to X . [From *Casey's Sequel to Euclid*, Part I., page 144.]

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Let P be any point on the circle of similitude, AP, BP the tangents from P to X and Y , respectively. AD, BC the tangents from A and B to Y and X , respectively.

Let $AX=R, BY=r$. Let $AD=a, BC=b, AP=c, BP=d, PX=m, PY=n$.

$\angle APX = \angle BPY$ since P is on circle of similitude. $\therefore \angle APY = \angle BPX = \theta$.

Also, $c:d=R:r$. $\therefore d=cr/R \dots (1)$.

$m:n=R:r$. $\therefore n=mr/R \dots (2)$.

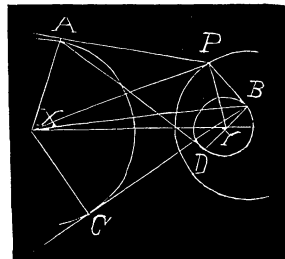
$$a^2 = AY^2 - r^2 = c^2 + n^2 - 2cn \cos \theta - r^2 \\ = c^2 + m^2 r^2 / R^2 - (2cmr/R) \cos \theta - r^2 \dots (3).$$

$$b^2 = RX^2 - R^2 = d^2 + m^2 - 2dm \cos \theta - R^2 = c^2 r^2 / R^2 + m^2 - (2cmr/R) \cos \theta - R^2 \dots (4).$$

$$(3) - (4) \text{ gives } R^2(a^2 - b^2) = (c^2 - m^2 + R^2)(R^2 - r^2).$$

$$\text{But } c^2 + R^2 = m^2.$$

$$\therefore a^2 - b^2 = 0. \quad \therefore a = b.$$



CALCULUS.

106. Proposed by M. C. STEVENS, M. A., Professor of Higher Mathematics, Purdue University, Lafayette, Ind.

$$\int_0^\pi \frac{\cos rx dx}{1-2a \cos x + a^2} = \frac{\pi a^r}{1-a^2}.$$

[Williamson's *Integral Calculus*, 6th Edition, page 174.]

Solution by WILLIAM HOOVER, A.M., Ph.D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

In Todhunter's *Plane Trigonometry*, 3d Edition, Art. 309, we have

$$\cos \alpha + a \cos(\alpha + \beta) + a^2 \cos(\alpha + 2\beta) + \dots + a^{n-1} \cos[\alpha + (n-1)\beta]$$